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(54) **Interchangeable probe head**

Auswechselbarer Probekopf

Sonde à tête interchangeable

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Description

The present invention relates to a probe head used on a coordinate positioning machine to orient a touch trigger probe (for example) relative to the movable arm (or quill) of the machine. The coordinate positioning machine may e.g. be either a coordinate measuring machine or a machine tool.

It is known (from "Probing for Productivity on Coordinate Measuring Machines" RENISHAW) to provide a two-axis motorised probe head for orienting a probe relative to the quill of a machine with two degrees of rotational freedom. Such a probe head comprises a support, which is connectable to the quill of a machine, and a pair of serially mounted rotors, each of which is engageable in, and may rotate between a plurality of indexed positions. A probe is connected to the "free" rotor, and is oriented relative to the quill by rotation of one or both of the rotors about their respective axes. Indexing of position between two relatively rotating parts is provided by a ring of balls on one of the parts, and three seating members on the other part, each of which seats in the convergent surfaces provided by an adjacent pair of balls. Thus, at each of the indexed positions each rotor is kinematically supported; this provides maximum positional repeatability of the probe at each indexed position.

An inventive concept claimed in the parent to the present application relates to a system for interchanging a number of probes upon an indexing probe head of the type described above, in which each of the probes to be supported on the probe head is mounted to a carrying member which, in use, forms the rotor of the probe head.

More particularly, the parent application provided a probe head for orienting a probe relative to the movable arm of a coordinate positioning machine, comprising:

a support by which the probe head is connectable to the arm of the machine;
a rotor for carrying a probe;
retaining means for releasably retaining the rotor on the support, to enable one rotor to be exchanged for another;
indexing means for providing a plurality of indexed angular positions of the rotor relative to the support, comprising a first set of engagement elements provided on one of the rotor and support, and a plurality of sets of second engagement elements provided on the other of the rotor and support, said first set of engagement elements being engageable with each set of said plurality of sets of second engagement elements to provide, at each indexed position, a stable, repeatable rest position of the rotor on the support;
coupling and decoupling means for engaging and disengaging said first set of engagement elements with a set of said second engagement elements; and
driving means for rotating said rotor relative to said support substantially about an axis when said first and second engagement elements are disengaged, thereby to rotate said rotor from one indexed position to another.

Further preferred features of the parent application (employed either separately, or in various combinations) were as follows:

said retaining means comprises a magnet provided on one of the rotor and support, and a ferromagnetic element provided on the other of the rotor and support to axially urge said first and a said second set of engagement elements into engagement;
said driving means are provided by an axially movable drive dog on the support, said drive dog having a set of detent elements configured to engage a corresponding set of detent elements provided on said rotor;
said coupling and decoupling means are provided by said axially displaceable drive dog;
said magnet and ferromagnetic element are each provided on one of the drive dog and rotor.

Thus, are the number of parts which are coupled and uncoupled during normal operation reduced by utilising the first and second engagement elements for both indexing and probe change functions.

In use, each probe required by the machine is connected to a separate rotor, all of which are retained on the machine. When a particular inspection cycle requires a change of probe, this is achieved by exchanging rotors.

Preferably, the rotor will be magnetically retained on the support. Preferably, an axially movable drive dog is engageable with the rotor to uncouple the first and second engagement elements and thus enable rotation of the rotor between indexed locations. Rotation between indexed locations is preferably also performed by the drive dog.

The present application relates to a probe head for orienting a probe relative to the moveable arm of a coordinate positioning machine, comprising:

a support by which the probe head is connectable to the moveable arm of the machine;
a rotor for carrying a probe, and is rotatable relative to the support about an axis;
indexing means, for providing a plurality of angularly indexed positions of the rotor relative to the support, comprising first and second sets of mutually engageable indexing elements on the rotor and support respectively, said indexing elements being mutually engageable in a plurality of angular orientations about said axis, to provide, at each indexed position, a stable repeatable rest position of the rotor on the support;

coupling and decoupling means for engaging and disengaging said first and second sets of engagement elements;
driving means for rotating said rotor relative to said support substantially about said axis when said first and second sets of indexing elements are disengaged, thereby to rotate said rotor from one indexed position to another; characterised in that:
said driving means comprises first and second sets of mutually engageable driving elements provided on the rotor and support, and wherein said driving elements are disengageable during coupling of said first and second sets of indexing elements.

An embodiment of the invention will now be described, by way of example, and with reference to the accompanying drawings in which:

Fig 1 is a section through a probe head according to the present invention;

Fig 2 is a section on II-II in Fig 1; and

Fig 3 is a further section through the probe head of the present invention.

Referring now to Fig 1, a probe head 10 comprises a support 12 by which the probe head 10 may be carried on the movable arm, of quill of a coordinate positioning machine (such as a coordinate measuring machine or machine tool). A rotor 14, whose purpose is to carry a probe 16, is releasably retained on the support 12 by retaining means in the form of a permanent magnet 18 provided on a drive dog shaft 20 which cooperates with a ferromagnetic element in the form of a further magnet 22 provided on the rotor 14. A first set of engagement elements in the form of three adjacently positioned, equispaced pairs of rollers 24 is provided on the support 12. A plurality of sets of second engagement elements in the form of a ring of balls 26 is provided on the rotor 14; when the rotor 14 is retained on the support 12 by the action of magnets 18,22, three of the balls 26 seat in the convergent surfaces defined by adjacently positioned pairs of rollers 24. The pairs of rollers 24 are included a series of electrical circuits (not shown) which is completed when each of a set of three balls 26 seat in the convergent surfaces of adjacently positioned pairs of rollers, thus indicating that the rotor 14 is correctly retained on the support 12.

The rotor 14 may be oriented in any one of a plurality of indexed angular positions relative to the support 12 by disengaging each of a set of three balls 26 from the rollers 24, rotating the rotor 14 relative to the support 12, and engaging a further set of three balls 26 with the rollers 24. N.B. the number of sets of three balls 26 thus determines the number of indexed angular positions which the rotor 14 may adopt relative to the support 12.

Disengagement of balls 26 and rollers 24 is achieved by axial movement of the drive dog shaft 20 to engage each of three vee-groove detent elements 28 provided on the magnet 18 with three further balls 30 provided on the rotor 14, and subsequently axially displacing the rotor 14 until the balls 26 are moved clear of the convergent surfaces of adjacently positioned pairs of rollers 24. The magnetic attraction between the magnets 18 and 22 ensures that the rotor 14 does not fall off during this operation. Axial movement of the drive dog shaft 20 is actuated by a motor 32, which also rotates the drive dog shaft 20, thereby to orient the rotor 14 in a different indexed angular position. Once oriented, the motor 32 is controlled to retract the drive dog shaft 20 and bring a further set of three balls 26 into engagement with the rollers 24. The motor 32 continues to withdraw the drive dog shaft 20 until the magnets 18,22 lose contact with each other. However, the magnetic force between the magnets 18,22 is sufficient to ensure the rotor 14 is retained securely upon the support 12 in the new indexed position. The probe 16 may thus be positioned at a plurality of angular indexed locations, at each of which the rotor 14 is kinematically supported the support 12. The rotor 14 is thus in a stable and repeatable position relative to the support at each of the aforementioned angular positions.

At each of the indexed angular positions, the centre point O of the rotor 14 will lie at a fractionally different position relative to the axis A of the drive dog shaft 20. This is a result of the tolerances associated with positioning the ring of balls 26 and the rollers 24. The rotor 14 may thus be described as having a "wandering axis" relative to the support 12; nonetheless for practical purposes the rotor 14 is rotatable about the axis A.

When it is desired to exchange the probe 26 for a different type of probe, the entire rotor 14 is removed from the support 12, and a new rotor is mounted thereon. The dual function of the balls 26 and rollers 24 as both indexing elements and retaining elements thus serves to eliminate the existing releasable connection between a probe head and a probe.

In a modification to the present invention, the magnet 18 may be provided at a plurality of positions around the drive dog shaft 20 on the fixed part of the support 12; this eliminates the need to provide a magnet 18 at the end of the drive dog shaft 20.

Claims

1. A probe head for orienting a probe relative to the moveable arm of a coordinate positioning machine, comprising:

a support (12) by which the probe head is connectable to the moveable arm of the machine;
a rotor (14) rotatable relative to the support (12) about an axis (A) for carrying a probe (16);
indexing means (24,26), for providing a plurality

of angularly indexed positions of the rotor (14) relative to the support (12), comprising first and second sets of mutually engageable indexing elements (24,26) on the rotor (14) and support (12) respectively, said indexing elements (24,26) being mutually engageable in a plurality of angular orientations about said axis, to provide, at each indexed position, a stable repeatable rest position of the rotor (14) on the support (12);
coupling and decoupling means (18,20,22,32) for engaging and disengaging said first and second sets of indexing elements (24,26);
driving means (20,28,30,32) for rotating said rotor (14) relative to said support (12) when said first and second sets of indexing elements (24,26) are disengaged, thereby to rotate said rotor (14) from one indexed position to another;

characterised in that:

said driving means (20,28,30) comprises first and second sets of mutually engageable driving elements (28,30) provided on the rotor (14) and support (12), and wherein said driving elements (28,30) are disengageable during coupling of said first and second sets of indexing elements.

2. A probe head according to claim 1 wherein said coupling means comprises a pair of ferromagnetic elements (18,22), one on the rotor (14) and one on the support (12), and a motor (32) for increasing and decreasing the separation between the ferromagnetic elements (18,22).

3. A probe head according to claim 2 comprising an axially movable drive dog (20) on said support for engaging said rotor.

4. A probe head according to claim 3 wherein said driving elements (28,30) are provided on said drive dog (20) and said rotor (14).

5. A probe head according to claim 3 or claim 4 wherein said ferromagnetic elements (18,22) are provided on said drive dog (20) and rotor (14) thereby to provide said coupling means.

Patentansprüche

1. Sondenkopf zum Orientieren einer Sonde relativ zu dem beweglichen Arm einer Koordinatenpositionierungsmaschine, mit:

einer Stütze (12), durch die der Sondenkopf mit dem beweglichen Arm der Maschine verbindbar ist;

einem Rotor (14) zum Tragen einer Sonde (16), welcher relativ zu der Stütze (12) um eine Achse (A) drehbar ist;

Indizierungsmitteln (24, 26) zum Schaffen einer Vielzahl von winkelindizierten Positionen des Rotors (14) relativ zu der Stütze (12), welche erste und zweite Sätze von gegenseitig eingreifbaren Indizierungselementen (24, 26) auf dem Rotor (14) bzw. der Stütze (12) umfassen, wobei die Indizierungselemente (24, 26) gegenseitig in eine Vielzahl von Winkelorientierungen um die Achse eingreifbar sind, um an jeder indizierten Position eine stabile, wiederholbare Ruheposition des Rotors (14) auf der Stütze (12) zu schaffen;

Kupplungs- und Entkupplungsmitteln (18, 20, 22, 32) zum Eingreifen und Ausrücken der ersten und zweiten Sätze von Indizierungselementen (24, 26);

Antriebsmitteln (20, 28, 30, 32) zum Drehen des Rotors (14) relativ zu der Stütze (12), wenn die ersten und zweiten Sätze von Indizierungselementen (24, 26) ausgerückt sind, um dadurch den Rotor (14) von einer indizierten Position in eine andere zu drehen;

dadurch **gekennzeichnet,** daß:
die Antriebsmittel (20, 28, 30) erste und zweite Sätze von gegenseitig eingreifbaren Antriebselementen (28, 30) umfassen, die auf dem Rotor (14) und der Stütze (12) vorgesehen sind, und worin die Antriebselemente (28, 30) während des Kuppelns der ersten und zweiten Sätze von Indizierungselementen ausrückbar sind.

2. Sondenkopf nach Anspruch 1, worin die Kupplungsmittel ein Paar von ferromagnetischen Elementen (18, 22) umfassen, eines auf dem Rotor (14) und eines auf der Stütze (12), und einen Motor (32), um die Trennung zwischen den ferromagnetischen Elementen (18, 22) zu erhöhen und zu vermindern.

3. Sondenkopf nach Anspruch 2, mit einem axial beweglichen Antriebsmitnehmer (20) auf der Stütze zum Eingreifen in den Rotor.

4. Sondenkopf nach Anspruch 3, worin die Antriebselemente (28, 30) auf dem Antriebsmitnehmer (20) und dem Rotor (14) vorgesehen sind.

5. Sondenkopf nach Anspruch 3 oder 4, worin die ferromagnetischen Elemente (18, 22) auf dem Antriebsmitnehmer (20) und dem Rotor (14) vorgesehen sind, um dadurch die Kupplungsmittel zu schaf-

fen.

Revendications

1. Une tête de sonde pour orienter une sonde par rapport au bras mobile d'une machine à positionner à coordonnées, comprenant:

   un support (12) par lequel la tête de sonde est connectable au bras mobile de la machine;
   un rotor (14) rotatif par rapport au support (12) autour d'un axe (A) pour porter une sonde (16);
   des moyens d'indexage (24, 26), pour fournir une pluralité de positions angulairement indexées du rotor (14) par rapport au support (12), comprenant des premier et deuxième jeux d'éléments d'indexage mutuellement engageables (24, 26) sur le rotor (14) et sur le support (12) respectivement, lesdits éléments d'indexage (24, 26) étant mutuellement engageables dans une pluralité d'orientations angulaires autour dudit axe, pour fournir, à chaque position indexée, une position de repos répétable stable du rotor (14) sur le support (12);
   des moyens d'accouplement et de désaccouplement (18, 20, 22, 32) pour engager et dégager lesdits premier et deuxième jeux d'éléments d'indexage (24, 26);
   un moyen d'entraînement (20, 28, 30, 32) pour faire tourner ledit rotor (14) par rapport audit support (12) lorsque lesdits premier et deuxième jeux d'éléments d'indexage (24, 26) sont dégagés, pour faire tourner ainsi ledit rotor (14) d'une position indexée à une autre;

   caractérisée en ce que:

   ledit moyen d'entraînement (20, 28, 30) comprend des premier et deuxième jeux d'éléments d'entraînement mutuellement engageables (28, 30) fournis sur le rotor (14) et sur le support (12), et dans quoi lesdits éléments d'entraînement (28, 30) sont dégageables lors de l'accouplement desdits premier et deuxième jeux d'éléments d'indexage.

2. Une tête de sonde conformément à la revendication 1 dans quoi ledit moyen d'accouplement comprend une paire d'éléments ferromagnétiques (18, 22), un sur le rotor (14) et un sur le support (12), et un moteur (32) pour augmenter et diminuer la séparation entre les éléments ferromagnétiques (18, 22).

3. Une tête de sonde conformément à la revendication 2 comprenant un toc d'entraînement axialement mobile (20) sur ledit support pour engager ledit rotor.

4. Une tête de sonde conformément à la revendication 3 dans quoi lesdits éléments d'entraînement (28, 30) sont fournis sur ledit toc d'entraînement (20) et sur ledit rotor (14).

5. Une tête de sonde conformément à la revendication 3 ou à la revendication 4 dans quoi lesdits éléments ferromagnétiques (18, 22) sont fournis sur ledit toc d'entraînement (20) et sur le rotor (14) pour fournir ainsi ledit moyen d'accouplement.

Fig.1.

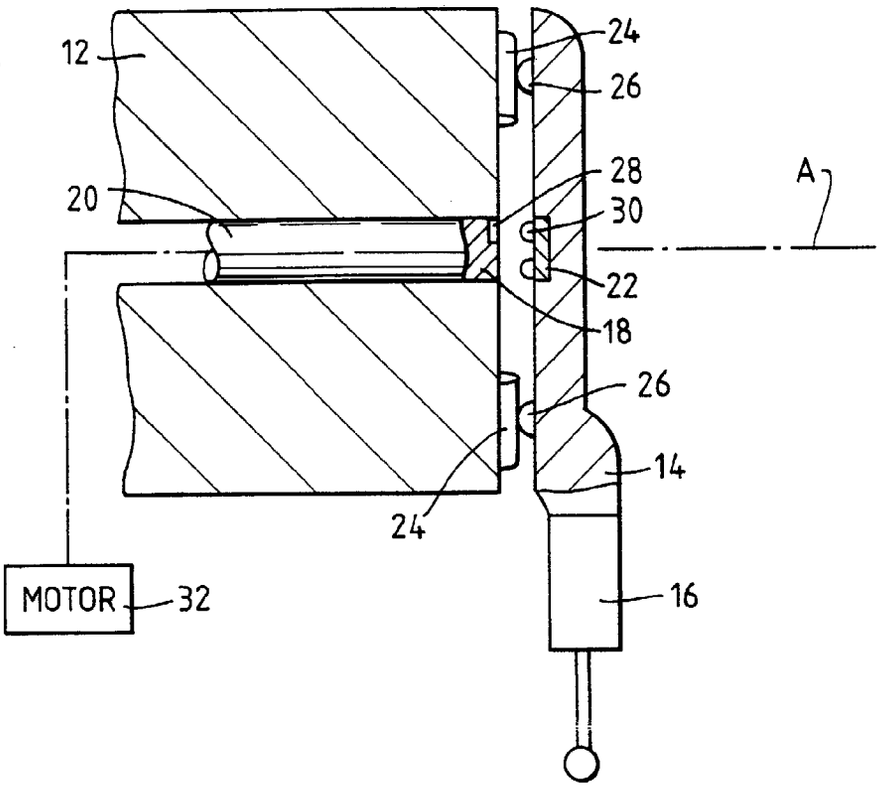

Fig.2.

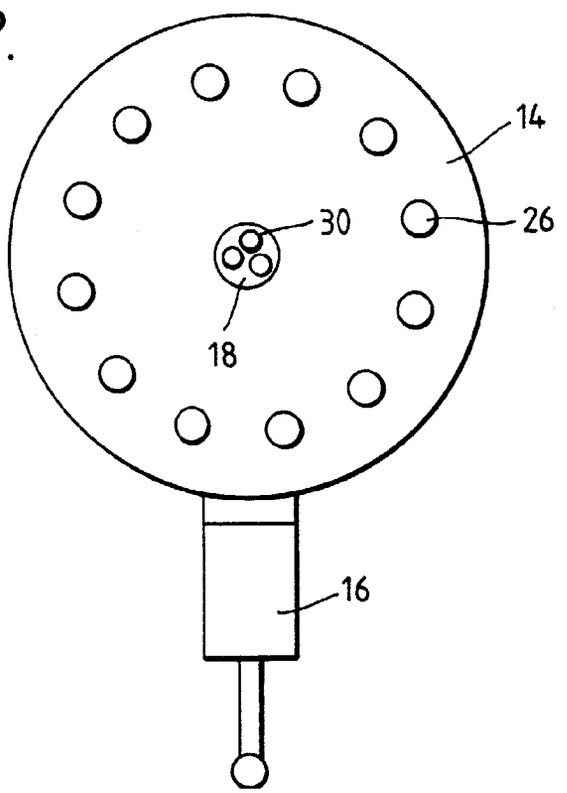

Fig. 3.